EC 4210   MIDTERM EXAM II   3/4/98

- This exam is open book and notes.

- There are three problems; each is equally weighted.

- Partial credit will be given; *be sure to do some work on each problem.*

- Be sure to include units in your answers.

- *Please circle or underline your answers.*

- Show *ALL* work.

- Do not do any work on this exam sheet.

1	
2	
3	
Total	

Name: _____

1. A germanium avalanche photodiode used in direct detection has the properties listed in the table. If the optimum value of gain is found to be 65.0, find the power in the incident beam.

Detector	Signal
Bulk dark current: 10 pA	Wavelength: 1300 nm
Quantum efficiency: 85%	Modulation index: 1.0
Excess noise factor: $F(M) = M^{1.0}$	Noise bandwidth: 500 MHz
Load resistance: 50 Ω	
Noise temperature: 350K	
Surface dark current: 0.01 pA	

2. Consider a source at an unknown temperature that is operating at the peak of the photon contrast. For this source, *calculate (with formulas)* the ratio of its spectral photon emittance to the value of the peak spectral photon emittance that it could have. (Note: do *not* use Fig. 19.7, except to check your answer.)

3. A staring IR system works in the atmospheric window between 4 μm and 5 μm. The average atmospheric transmission in that window is 90%.

   The receiving optics have a diameter of 8 cm and a focal length of 5 cm. The average transmission of the optics in the IR window is 85%. The detector is 1 mm x 1 mm. The bandwidth of the electronics is 100 kHz.

   A source has an emissivity of 90%, a temperature of 500K, and an emitting area of 3500 cm^2.

   When the system works against this source, the idealized range is found to be 20 km. Calculate the noise equivalent power of the detector.